Image from MODIS/NASA Earth Observatory

Merging remote sensing and models to improve performance and accessibility of snow information

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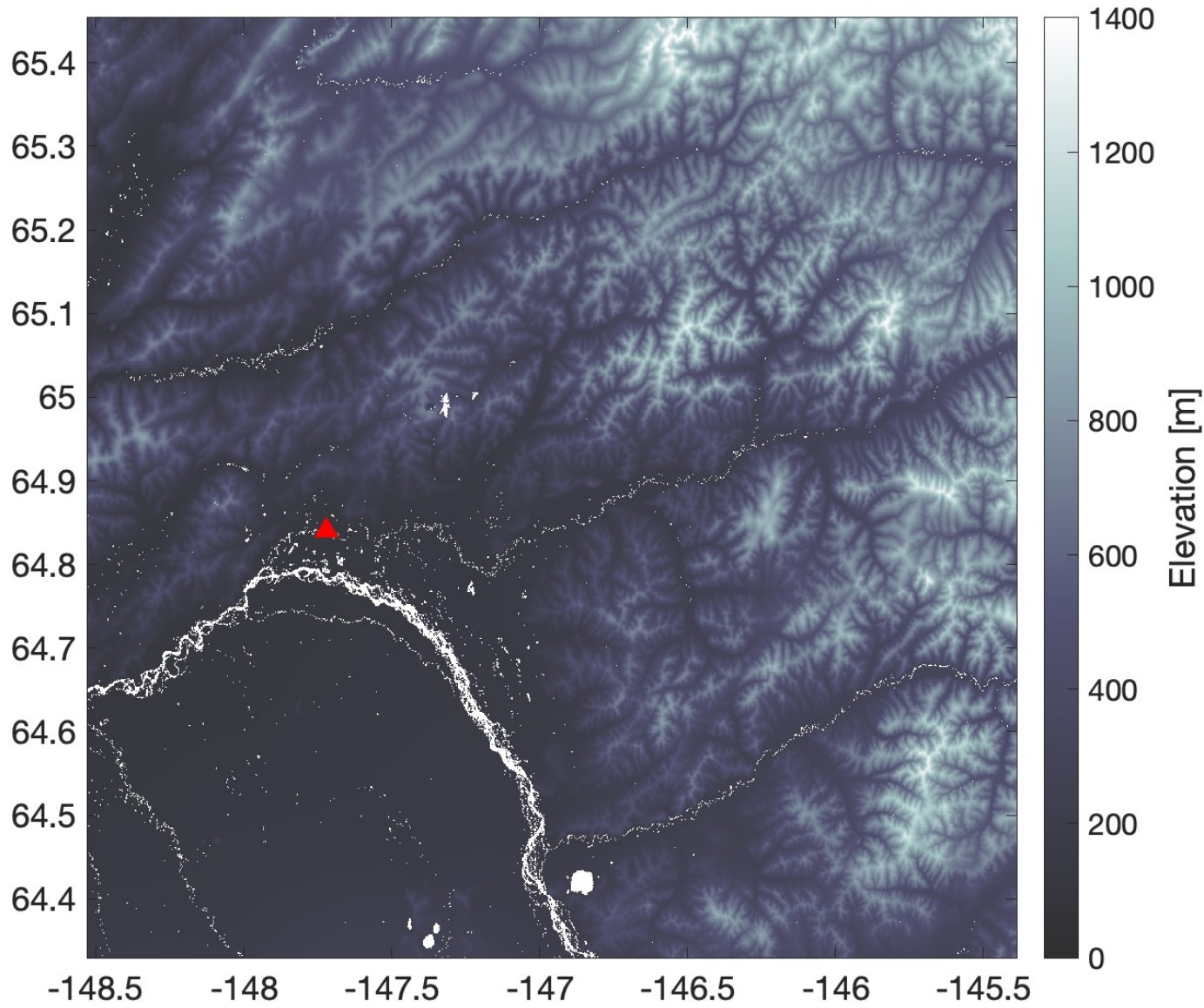
To support the NASA SnowEx Alaska campaign, we designed a model intercomparison effort designed to:

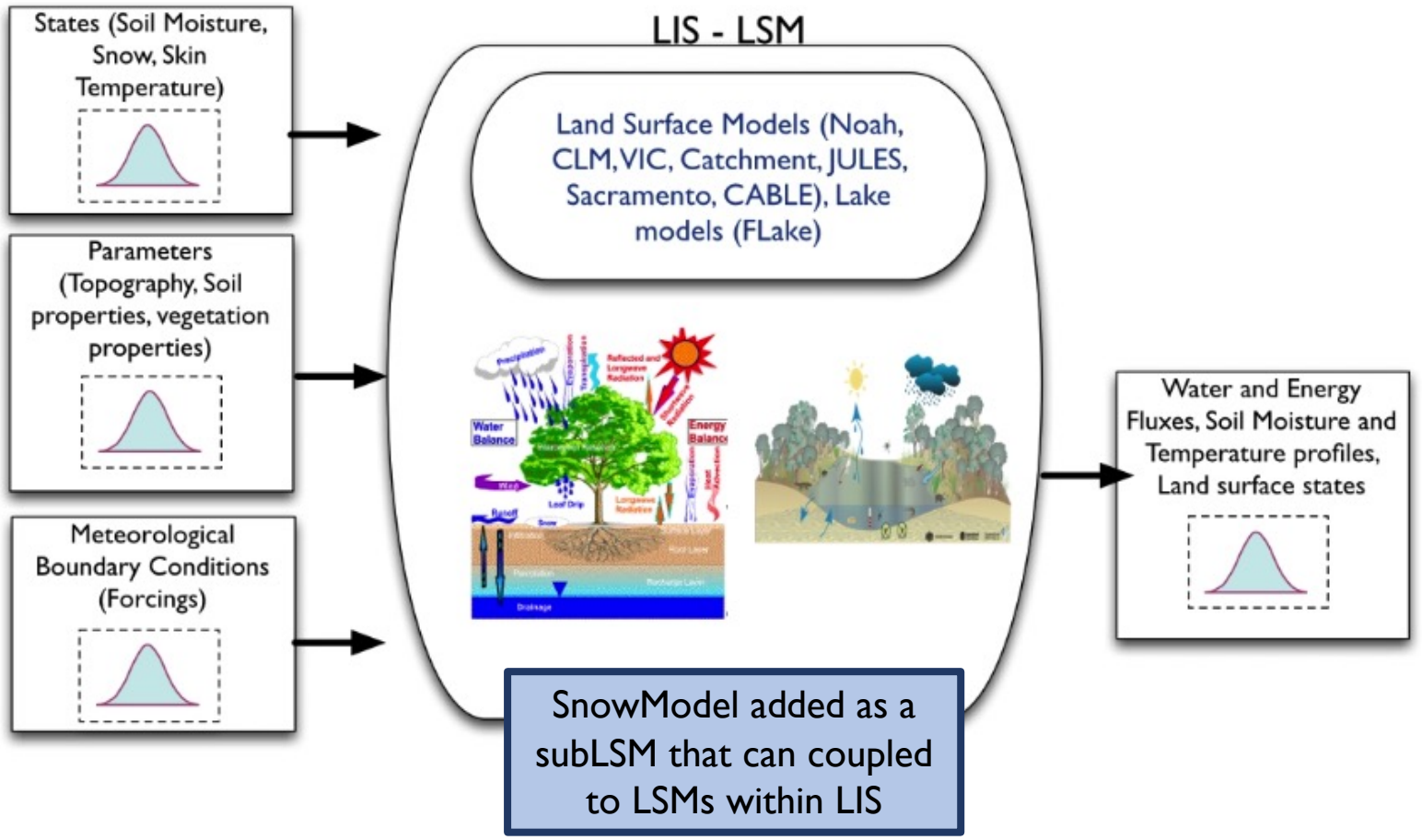
- understand where and when models agree/disagree
- determine where observations are needed to constrain model simulations
- test assimilation of observations collected during the campaign
- build a virtual field campaign

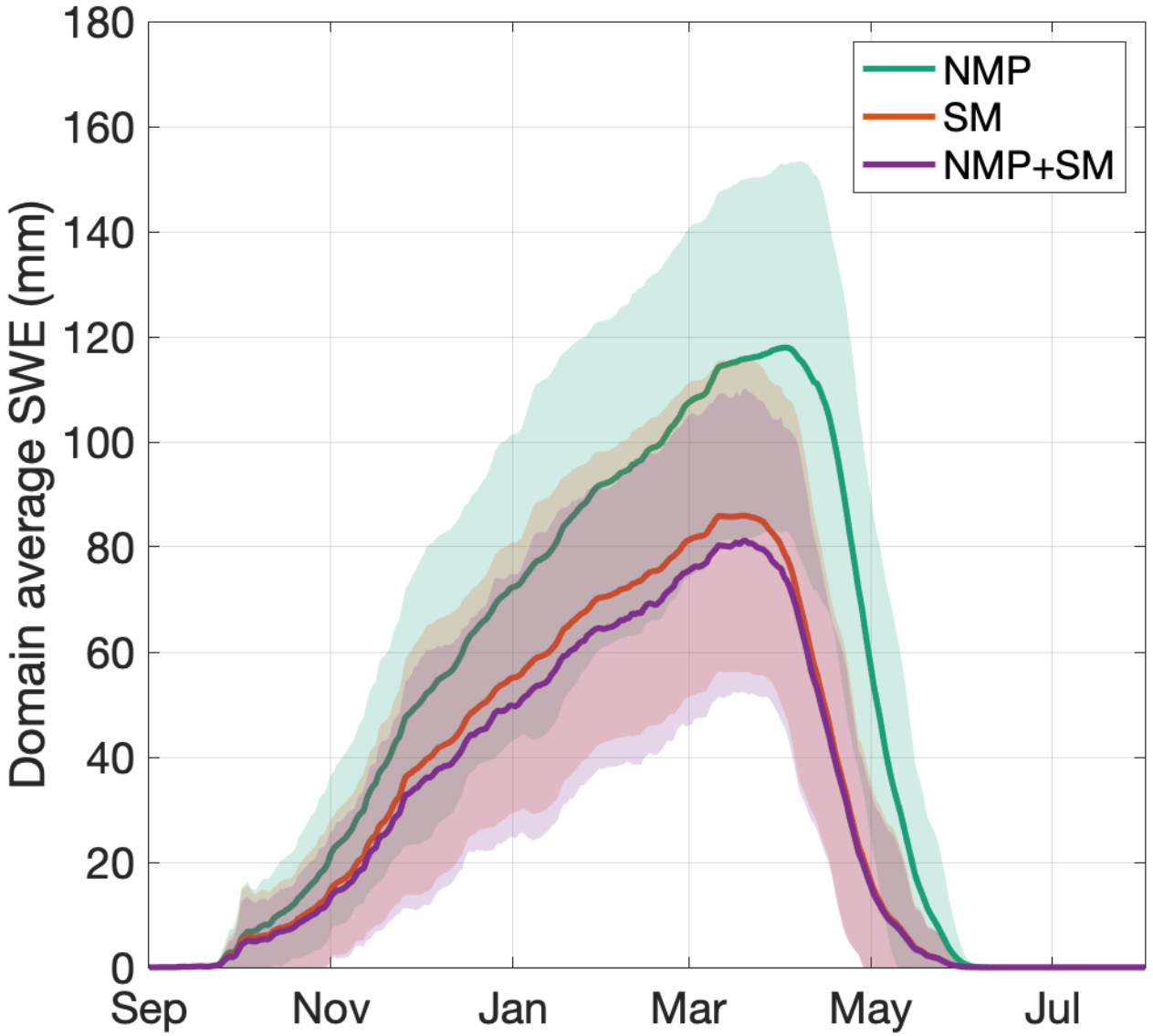


Red triangle indicates Fairbanks

Model setup

- Simulations run using the NASA Land Information System (LIS)
- 100 m spatial resolution
- Meteorological data from 4 km WRF simulation
- Daily output of SWE and snow depth for water years 2004-2015
- Three models:
  - NoahMP version 4.0.1
  - SnowModel
  - NoahMP+SnowModel coupled





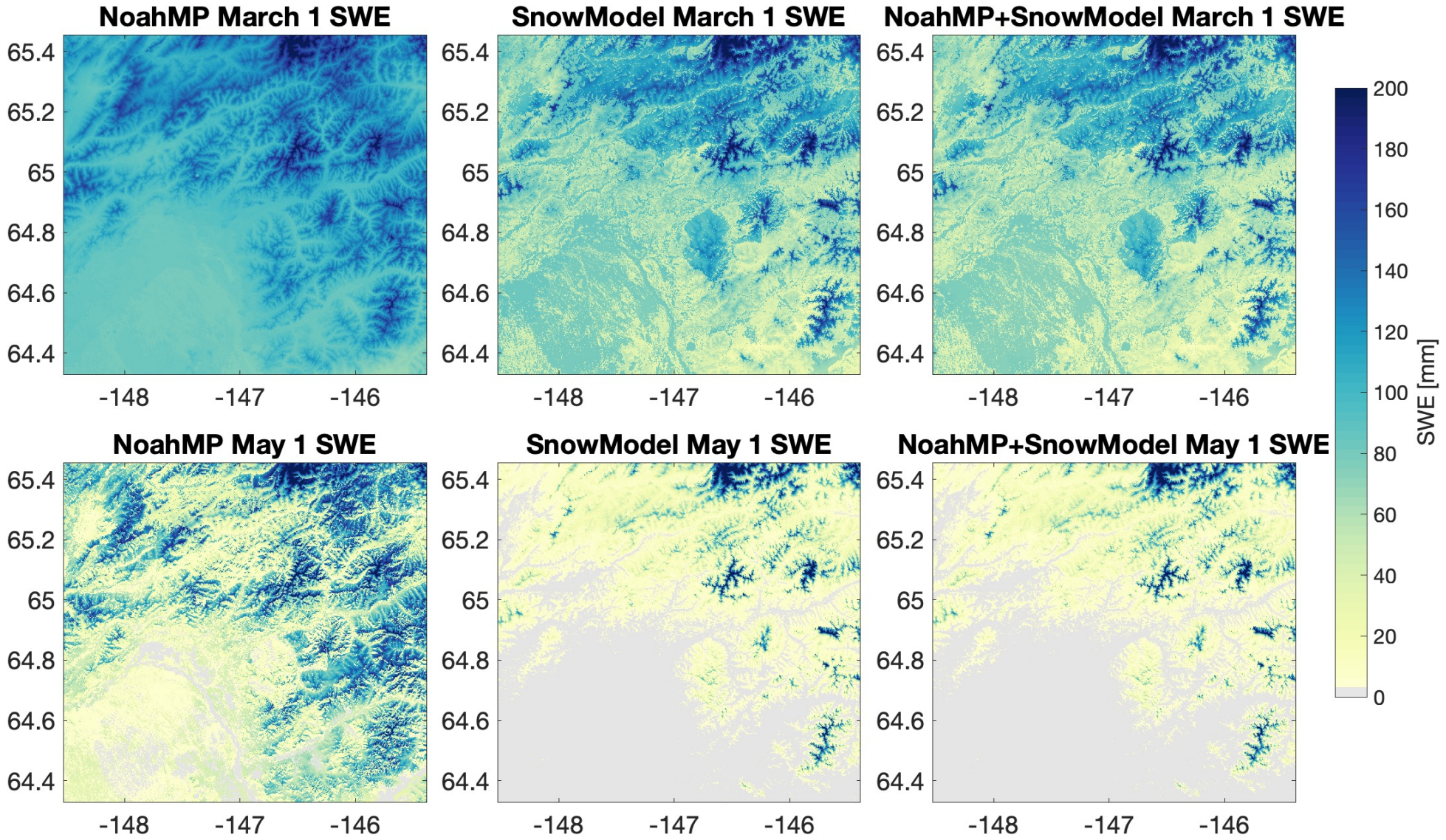
Water Year 2004-2015 average SWE

Solid line indicates the 12-year average from each model and the shading is +/- one standard deviation

- **NoahMP** begins to melt latest, though all three have similar snow off dates (~June 1st)
- **NoahMP+SnowModel** with less SWE than **SnowModel**
- **NoahMP** peak SWE ~37% larger the other models

Spatial maps of average SWE conditions on March 1 (top) and May 1 (bottom)

Before melt begins, **SnowModel** and **NoahMP+SnowModel** have less snow in lower elevations.
NoahMP snow disappearance is later than **SnowModel** or **NoahMP+SnowModel**



Integrating modeling efforts with SnowEx field campaign

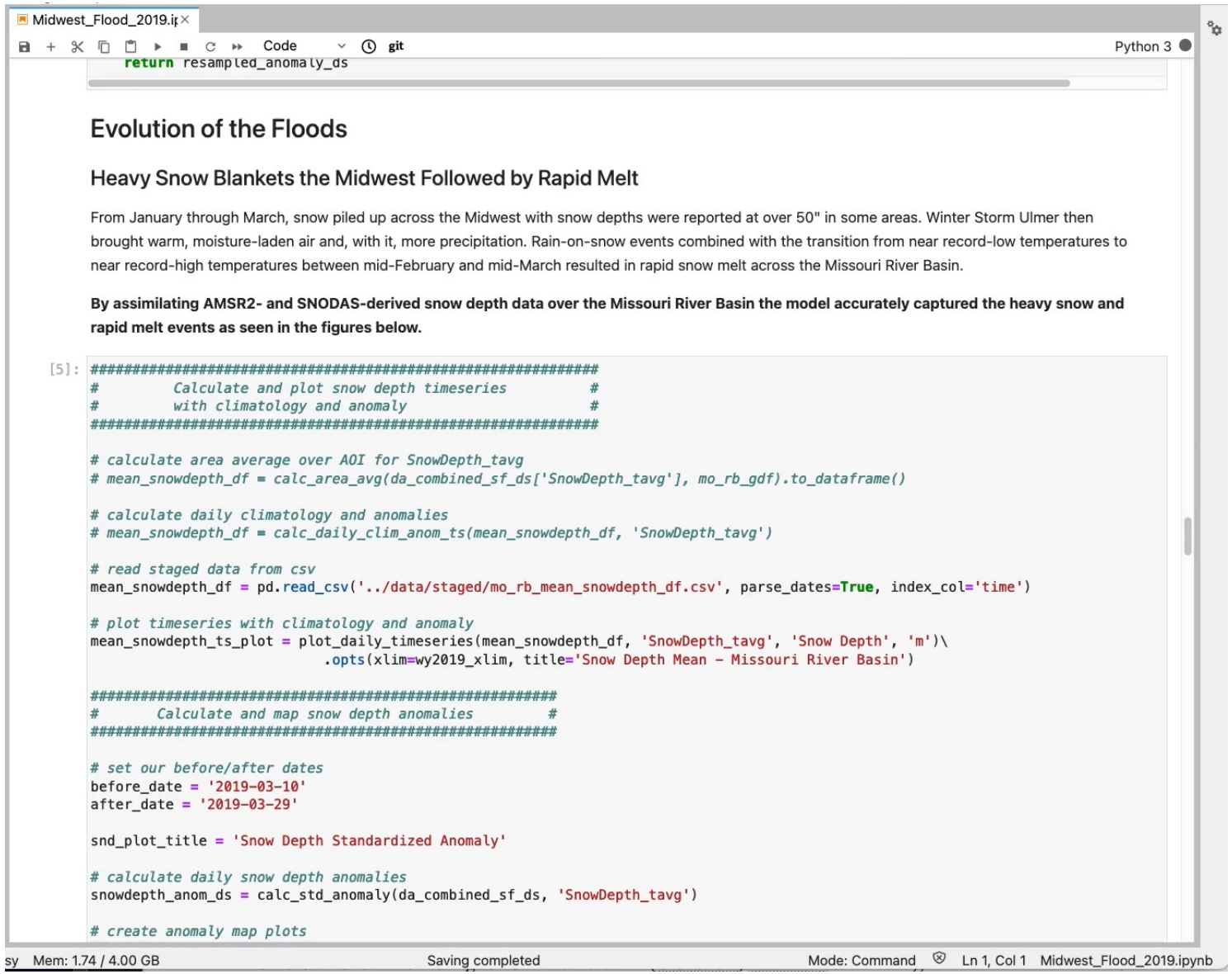
- Assimilation experiments will be performed once 2023 spring field data are available
- A virtual field campaign would tie together modeling and data collection efforts
  - Near real time modeling over Fairbanks and North Slope domains
  - Share preliminary snow depth measurements in real time
  - Open science concepts with Jupyter Notebooks for evaluating model simulations
  - Online platform would allow anyone to upload field data for comparison against models

Earth Information System efforts open and accessible science for improving understanding of the earth system

EIS is a NASA-wide effort that **integrates NASA's Earth Science observations and modeling capabilities** to produce new science and support decision making.

- Synthesize information about the water cycle by integrating available **remote sensing data** with advanced **models and data fusion tools**
- Provide an **open science environment** for addressing water security challenges facing the society
- Work with relevant **stakeholders** to provide **actionable information** about freshwater availability, quality, variability, and extremes

See https://eis.mysmce.com/ for more information!



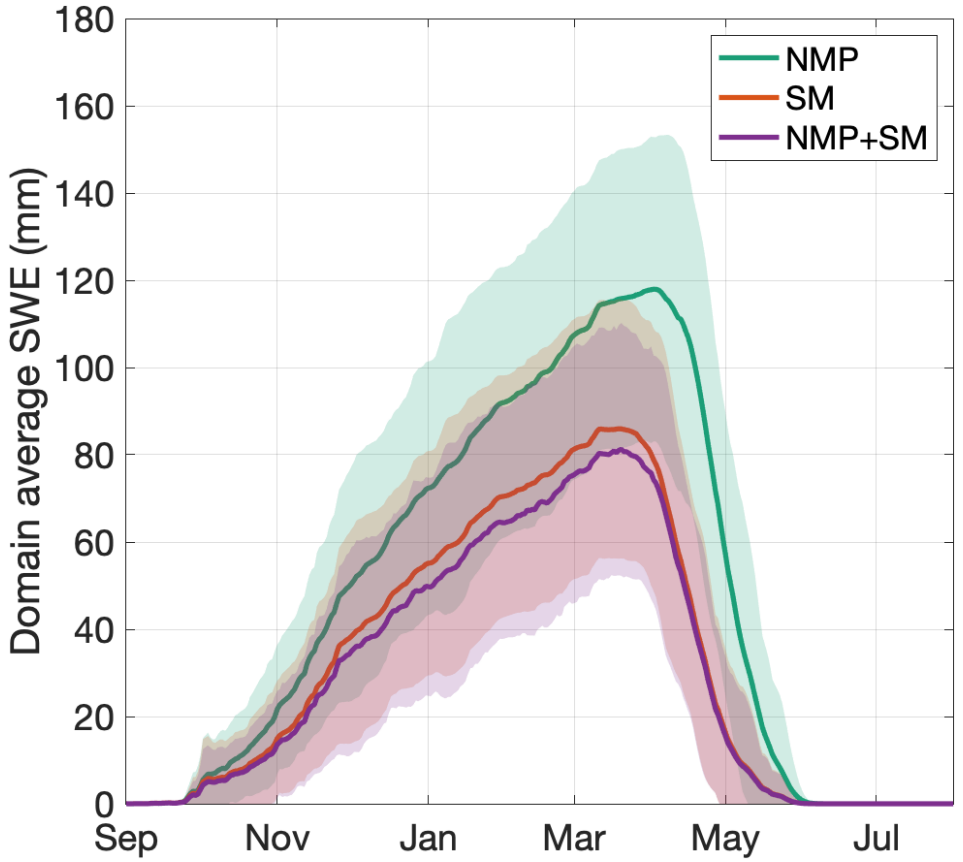
Open science tools

- Development of **Jupyter Notebooks** for case studies allows scientific users to **interact with the data** and perform analyses
- Open science encourages more **community engagement**
- EIS data shared at **SnowEx Hackweek** modeling tutorial

Hackweek tutorials available here:
https://snowex.hackweek.io/intro.html

Summary

- Model intercomparison efforts show:
  - **NoahMP** may have snow persist too long into the spring
  - **NoahMP+SnowModel** coupling reduces the late spring melt
  - **SnowModel** soon to be available in public LIS code
- A virtual field campaign could bring together modeling and field efforts, though framework still needs to be built
- Efforts like EIS and SnowEx are important for encouraging open science and community engagement



Thank you!

If you have any questions, please reach out!

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